AD-A162 619 DIFFUSION AND DEFLECT CHARACTERIZATION STUDIES OF MERCURY CADMIUM TELLURIDE(U) STANFORD UNIV CA DEPT OF MATERIALS SCIENCE AND ENGINEERING D A STEVENSON 1/1

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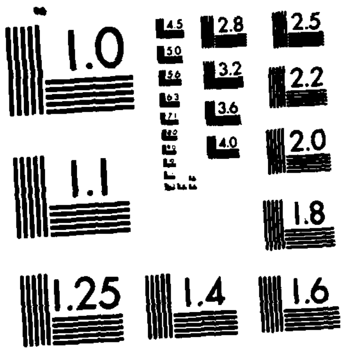

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OFFICE OF NAVAL RESEARCH

SEMI-ANNUAL REPORT/PROGRESS REPORT

for

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for

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Task No. NR (243-049)

"Diffusion and Defect Characterization Studies of
Mercury Cadmium Telluride"

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I. PROGRESS DURING THE REPORTING PERIOD

There have been two major activities during the first six months of this program:
Diffusion studies (interdiffusion and self diffusion) and growth studies in mercury cadmium telluride (MCT). In the former area, the necessary experimental techniques have been developed. In the latter area, several growth techniques have been evaluated to determine which are most appropriate for the objectives of the present programs. More details of these two activities are given below.

A. Self Diffusion Studies

Necessary experimental techniques have been developed, such as slicing, polishing and chemical etching of MCT wafers for diffusion hosts. Radioisotope techniques for Hg^{203} self-diffusion and subsequent sample sectioning techniques are in progress. The electron microprobe technique has been used to study HgCdTe/CdTe LPE junction interdiffusion. Our results show that without establishing an excess Hg vapor pressure, a selective loss of HgTe causes the LPE layer to be unstable. Above a certain critical Hg vapor pressure, the surface composition of LPE layer is stable and the Matano analysis can be applied to the final diffusion profile. Inter-diffusion between a HgTe/CdTe couple has been initiated, with the HgTe being synthesized in our lab. No pretreatment of HgTe and CdTe was made prior to the interdiffusion (eg. metal or non metal saturation) and the Hg vapor pressure was not fixed in

the diffusion ampoule. The interdiffusion coefficients for different X values obtained by Matano analysis are consistent with $\tilde{D}$ from previous studies (A.F.W. Willoughby, Materials Letters, 58 vol. 1, No. 2 (1982); V. Leute et al. Phys. Stat. Sol. (a)67, 183 (1981)). The $\tilde{D}$ value appears to be independentof component vapor pressure.

B. Growth of MCT

Exploratory experiments are being performed on three growth techniques, liquid phase electroepitaxy (LPEE), liquid phase epitaxy (LPE) and vapor phase epitaxy (VPE)in order to establish which methods show the best promise for the objectives of the present study. Work done on the LPE technique, using Te rich melts, for X=0.2 and temperatures of 500 and 550 C, has yielded results which support the work of Harman (T.C. Harman, J.Electronic Materials, Vol. 9 #6 (1980) pp. 945). Work on LPE from Hg rich melts has been discontinued since very large melts is in progress to evaluate this technique.

Major emphasis has been placed on the isothermal vapor phase epitaxial growth process (IVPE). We are studying the influence of the key growth parameters - temperature, source substrate distance, ambient Hg pressure, and source material - on the growth rate and the surface composition. We are exploring a model, based on present thermodynamic and phase equilibrium information, that will explain the general trends that have been documented in the current literature and by our work.

II. PLANNED ACTIVITIES FOR THE NEXT REPORTING PERIOD

The diffusion studies will continue, with emphasis on interdiffusion and tracer (self) diffusion. We will continue to explore several techniques for crystal growth in order to establish which methods are most suitable for our studies. It is anticipated that isothermal vapor phase epitaxy (IVPE) will receive the most emphasis.

III. PERSONNEL

There are no changes in the key personnel in the reporting period; Professor D. A. Stevenson is the Principal Investigator and James Fleming and Mei Tang are Ph.D. candidate graduate students.

IV. PROBLEMS AND AREAS OF CONCERN

Obtaining appropriate materials for substrates for growth and MCT diffusion hosts is a problem. We have established contacts with industry who are cooperative, however, it appears desirable that we have as much internal control as is possible over the preparation and processing of MCT and relevant substrates. As a consequence, growth activities will be enhanced. Our capability to produce specific compositions will also aid other studies of MCT at Stanford, particularly the studies of ion implantation carried out by Professor T. Sigmon's group.

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